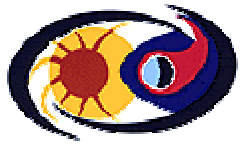

Magnetospheric Constellation Mission

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On Behalf of the Entire MCSTDT(*)

(Visit our website at http://sec.gsfc.nasa.gov/magcon.htm)

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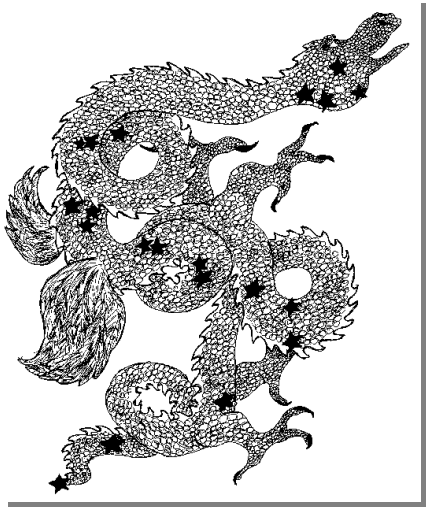
What is the
Magnetospheric Constellation Mission?

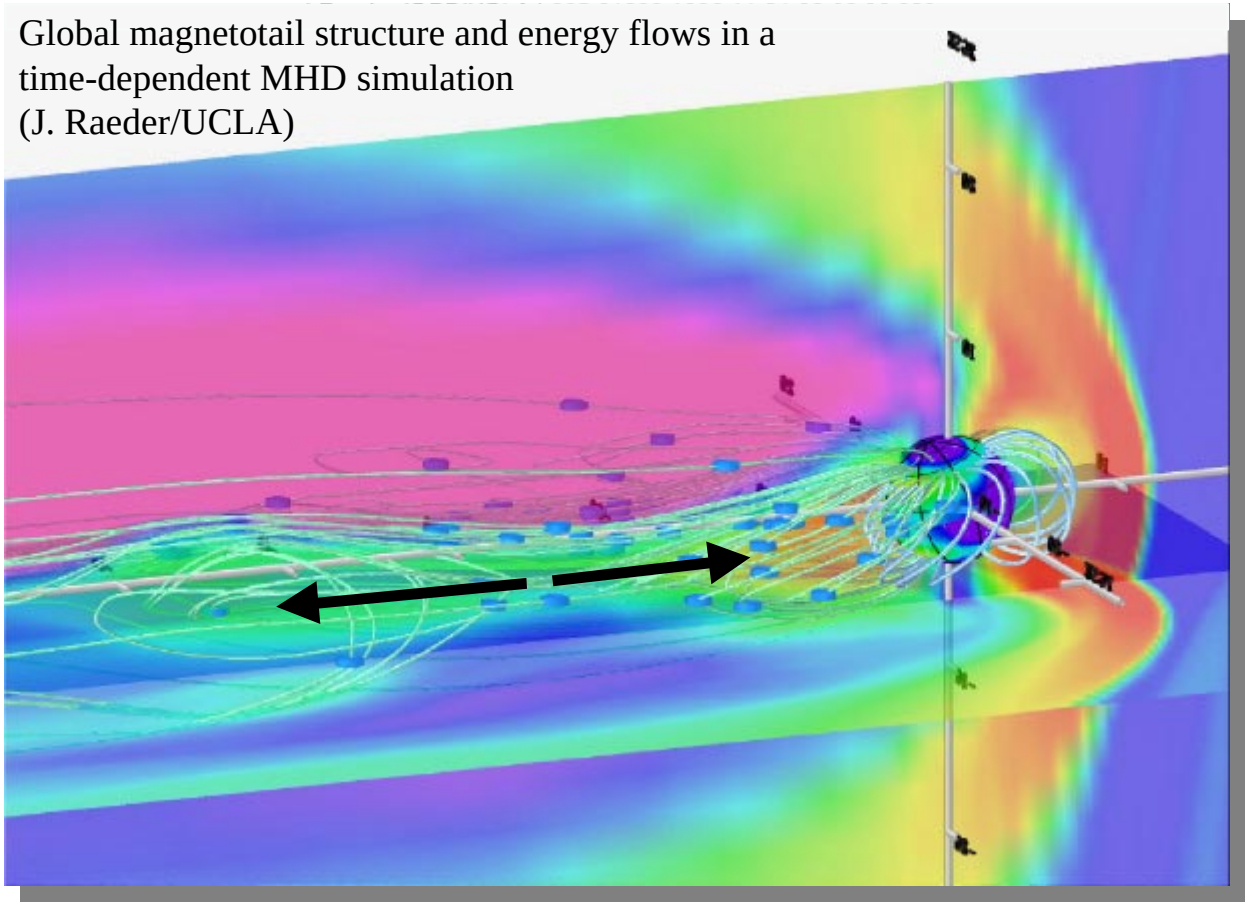
The Solar Terrestrial Probe for

Understanding Global Dynamics of the Structured Magnetotail

Dynamics,
Responses,
And
Coupling, from an
Observatory of
50-100 spacecraft



Global magnetotail structure and energy flows in a time-dependent MHD simulation
(J. Raeder/UCLA)

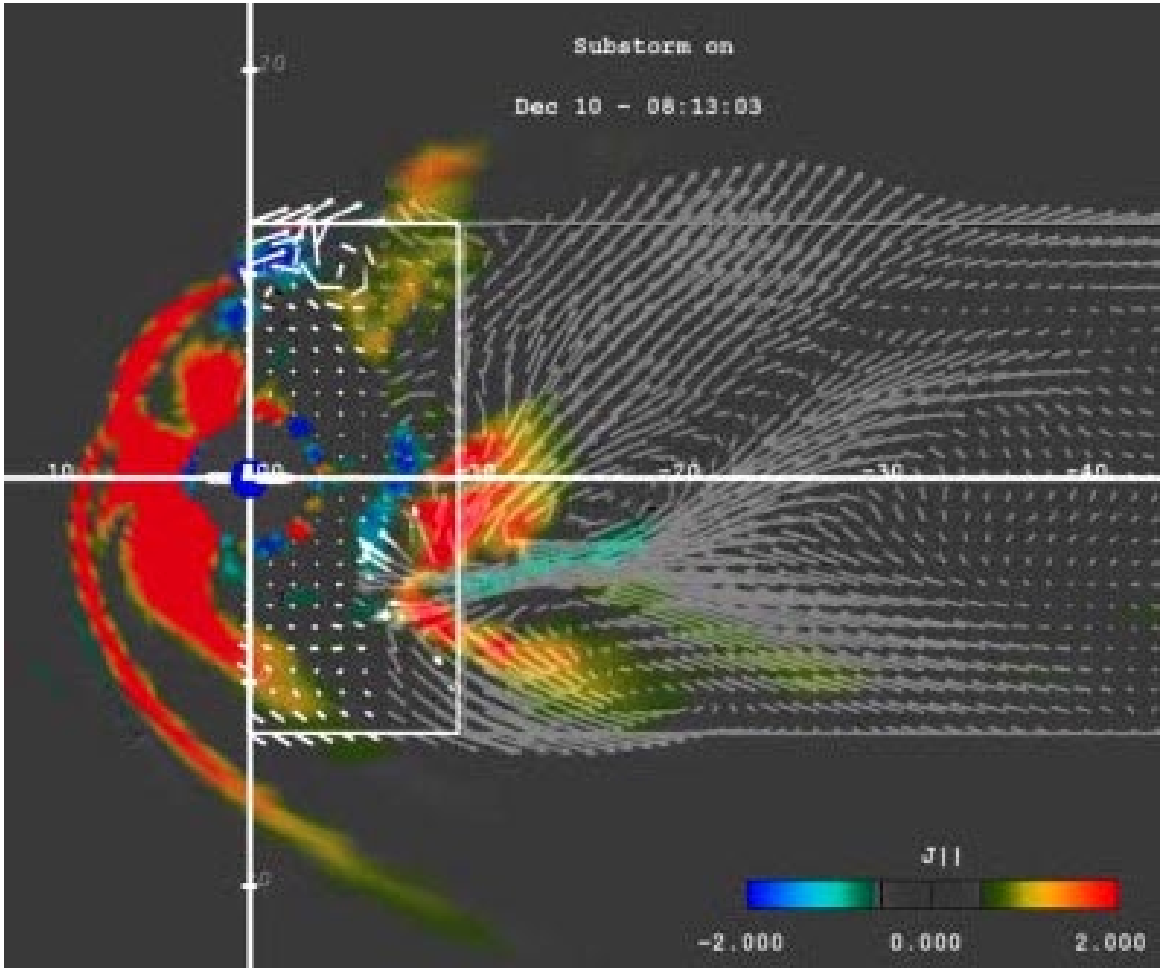


…the region controlling complex energy flows in the magnetosphere.

Why a Constellation Mission?

Observations and simulations show that the magnetotail is highly structured in space and time (L > ~1 Re; t >~ 10 sec)

Constellation DRACO will resolve space/time ambiguities which conceal the governing physical processes.



Regional flow bursts in the dynamic plasma sheet (C.Goodrich/J.Lyon)

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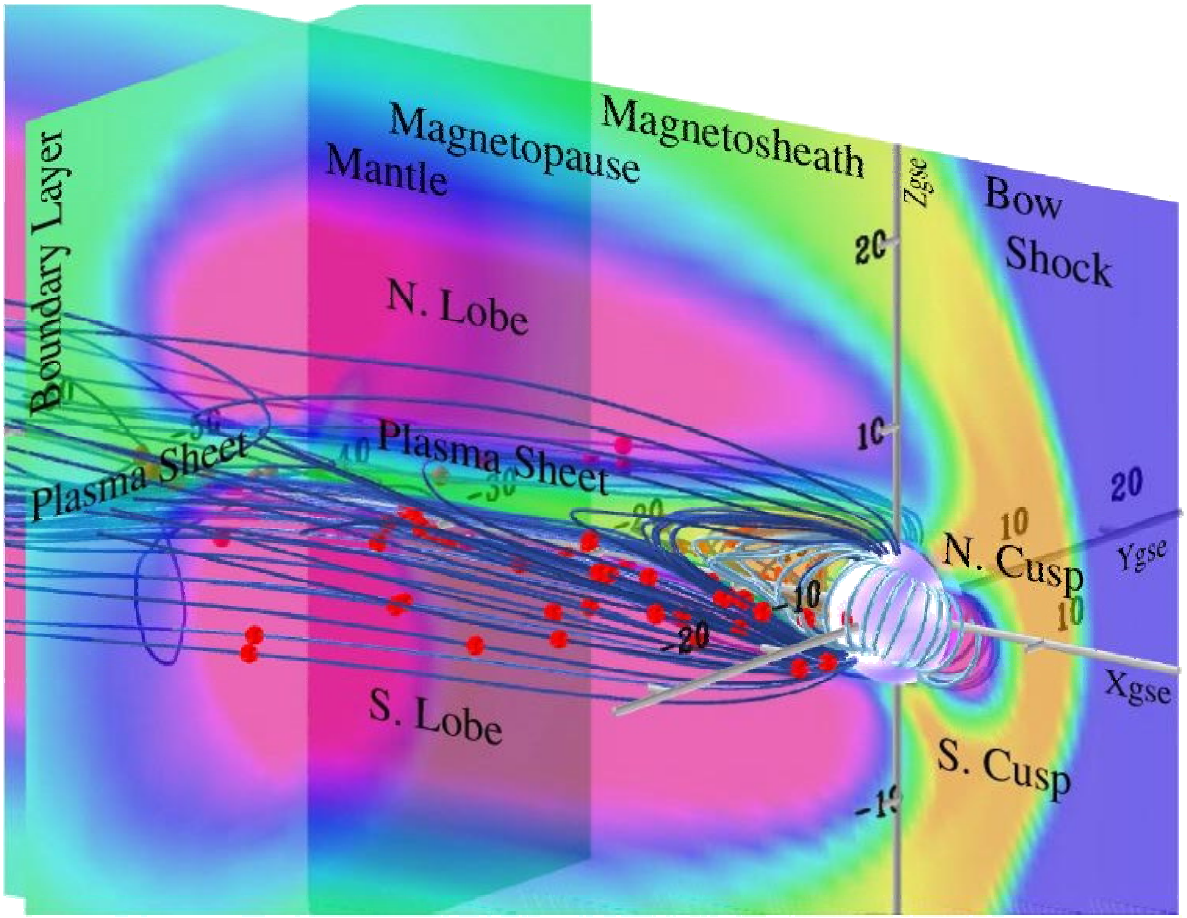
Physics Foundations

How does the magnetotail control energy flow?

- What processes control magnetotail structure and dynamics?
- How do the physical processes and regions couple over the hierarchy of scales?



Coupled magnetotail structures through which energy flows dynamically(J. Raeder/UCLA).

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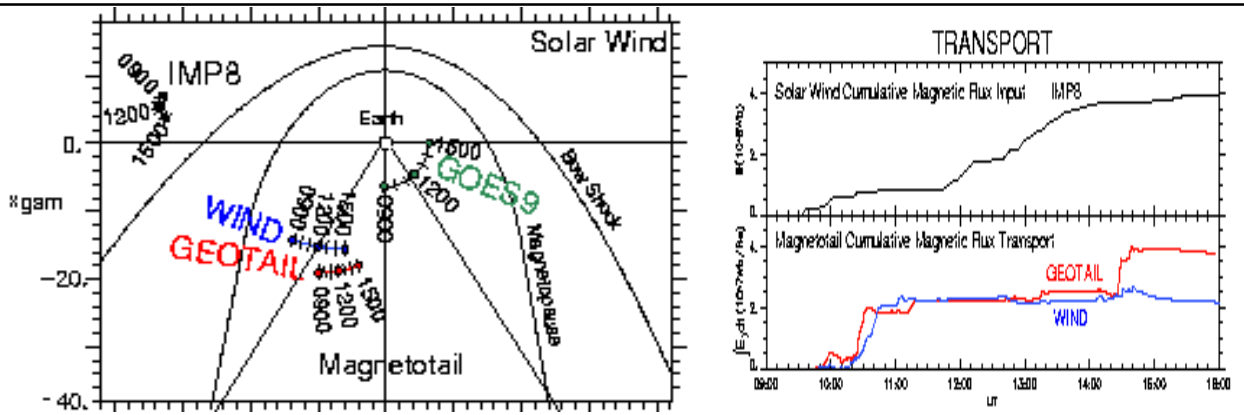
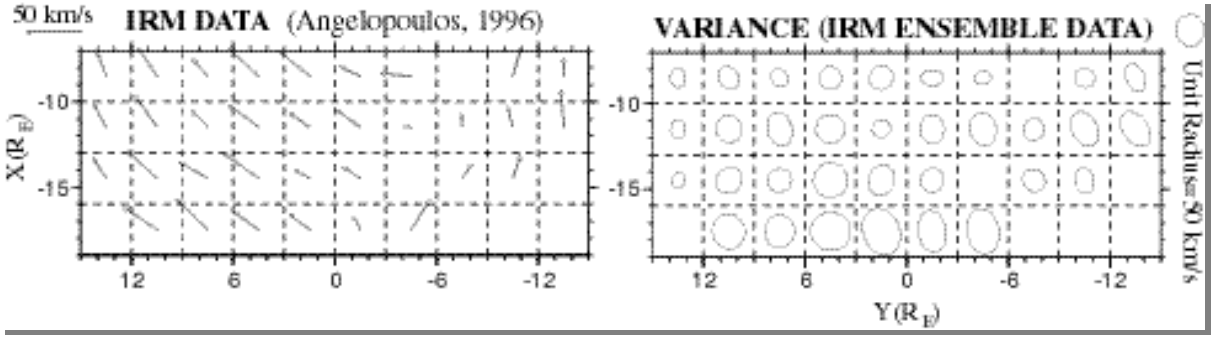
Physics Cornerstone #1: Dynamics

- **What is the nature of global magnetotail reconfigurations?**
- **Is the magnetotail dynamic for steady boundary conditions?**
- **How does the magnetotail accelerate and transport particles?**

DRACO will for the first time reveal the instantaneous configuration of the *dynamic* magnetotail.



Mesoscale structure masks true dynamics (Angelopoulos, 1999)



Variances are large relative to average – what is true instantaneous state?

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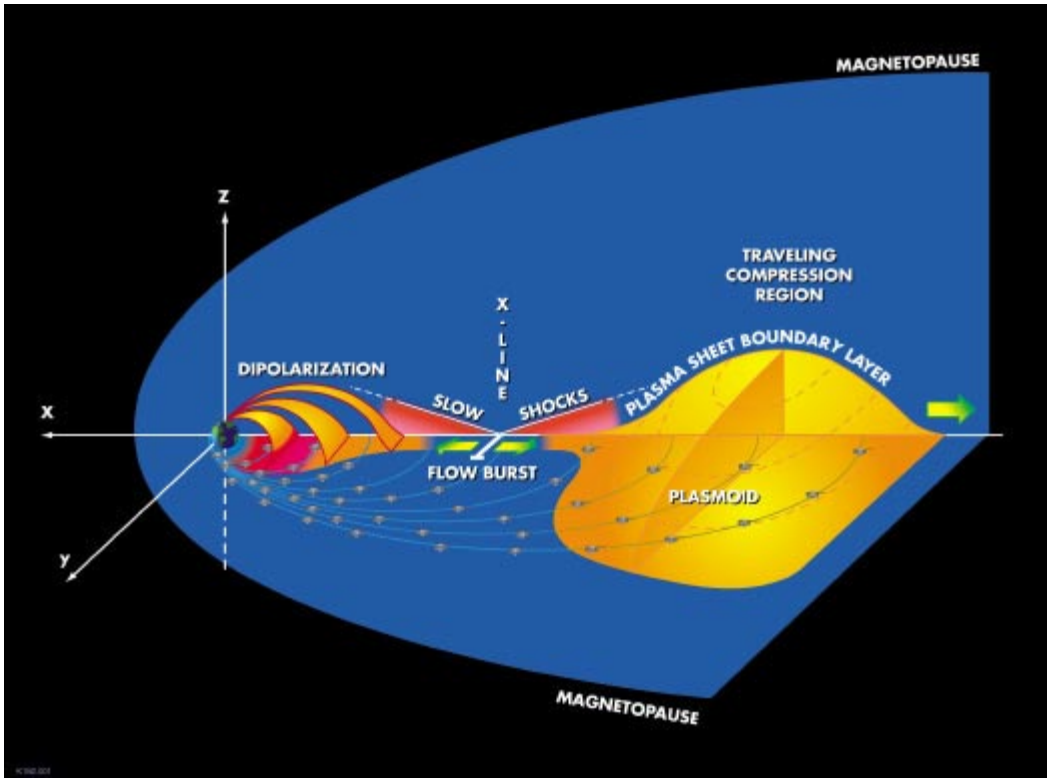
Physics Cornerstone #2: Responses

- **Are flow vortices and configuration changes generated spontaneously or driven externally?**
- **Are small-scale flow bursts related to large-scale plasmoids and dipolarizations?**

DRACO will determine and characterize the magnetotail's *responses* to external and internal drivers.



Magnetospheric substorm phenomena (Slavin et al.'99)

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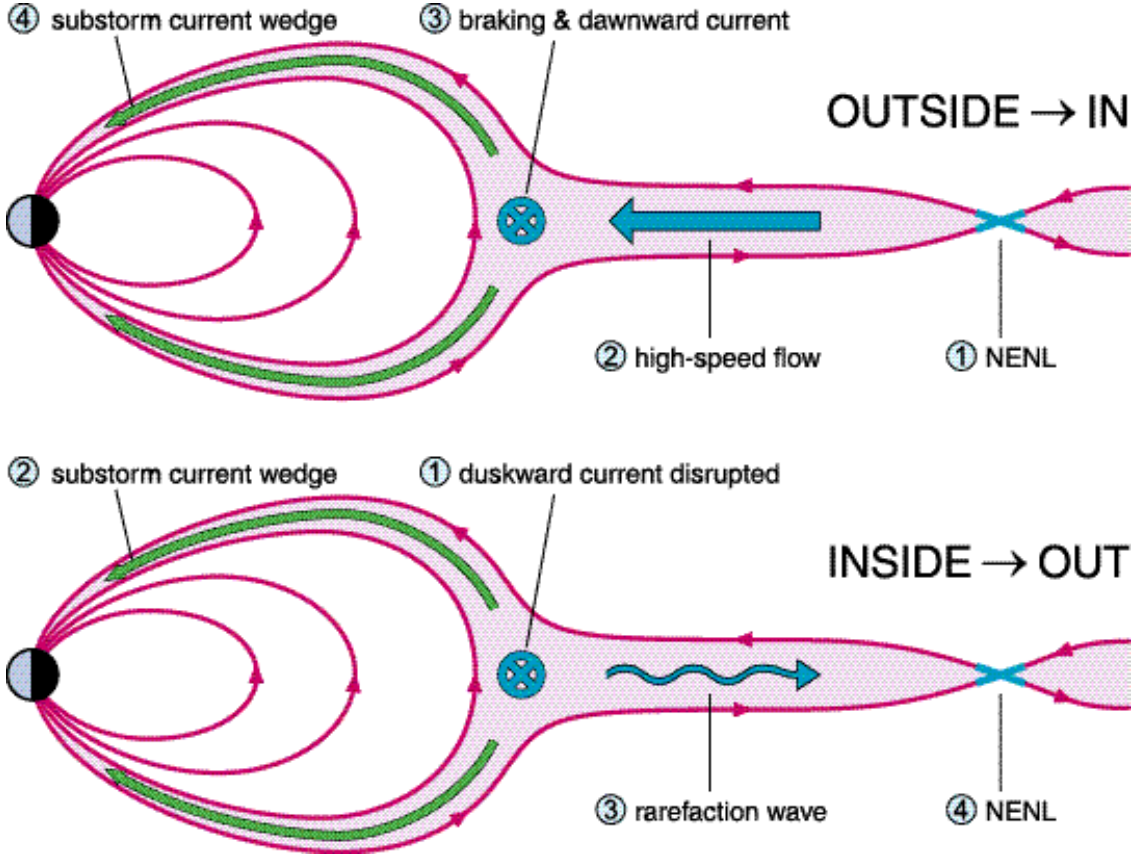
Physics Cornerstone #3: Coupling

- **Does the magnetotail reconfigure from the inside out (rarefactively) or from the outside in (compressively)?**
- **How does the magnetotail couple to the inner magnetosphere, ionosphere, and thermosphere?**

DRACO's measurement network will reveal the *coupling* between magnetotail regions and establish their cause-and-effect relationships.



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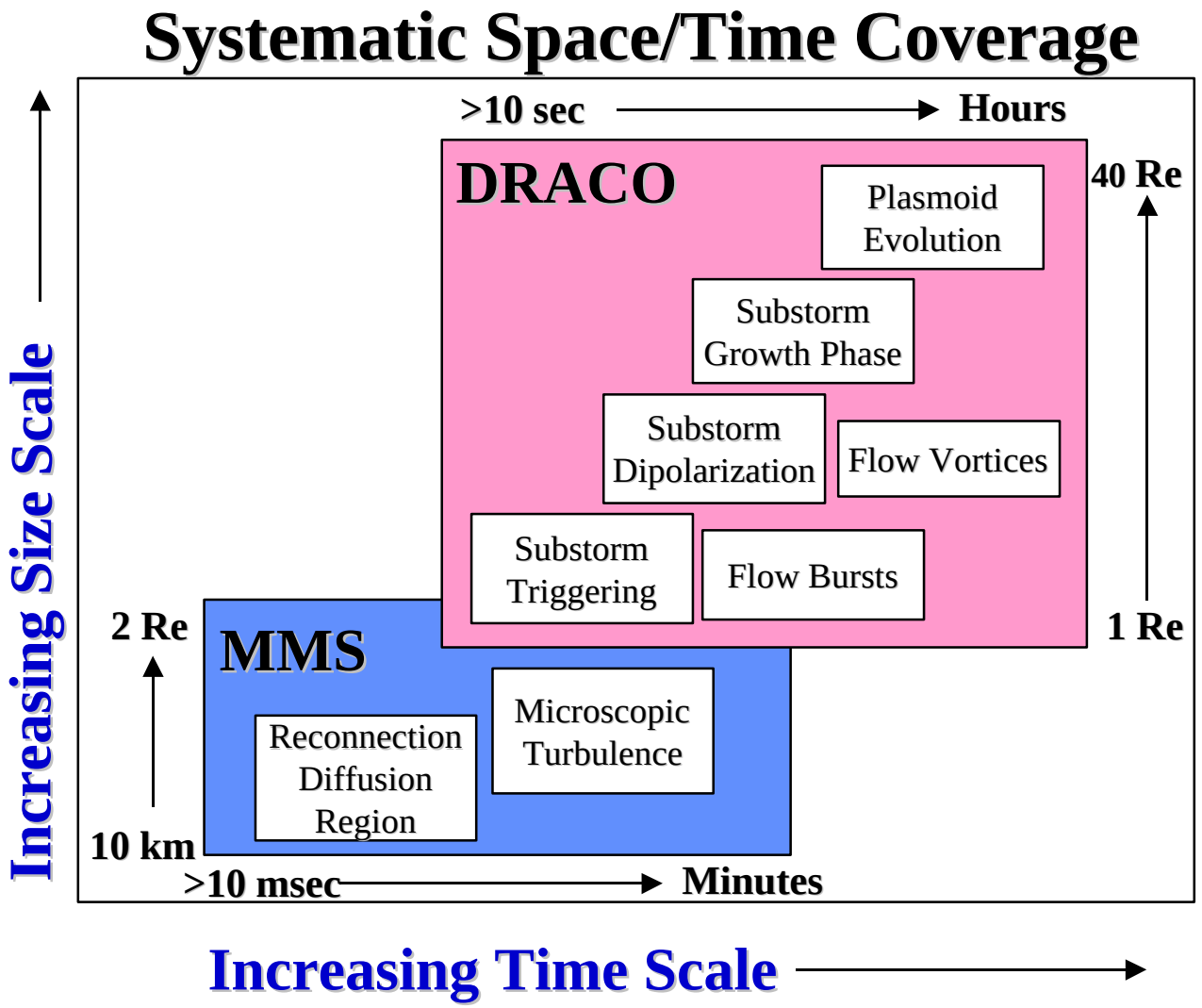
Complementarity with MMS

Single spacecraft have only glimpsed micro- and macro-physical processes.

The next logical step is to deploy spacecraft "networks" and requires both:

- MMS to resolve smaller size and shorter time scales; and,
- DRACO to resolve larger size and longer time scales.



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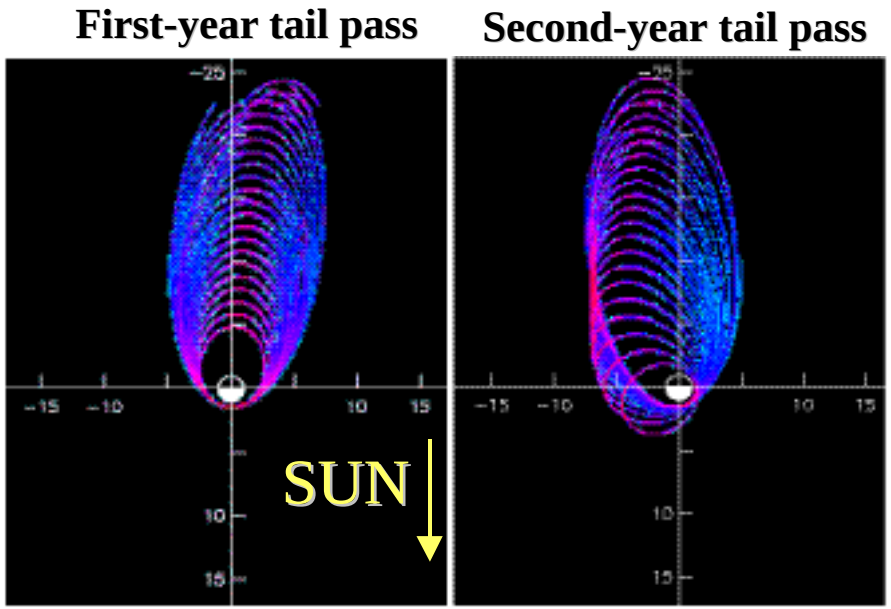
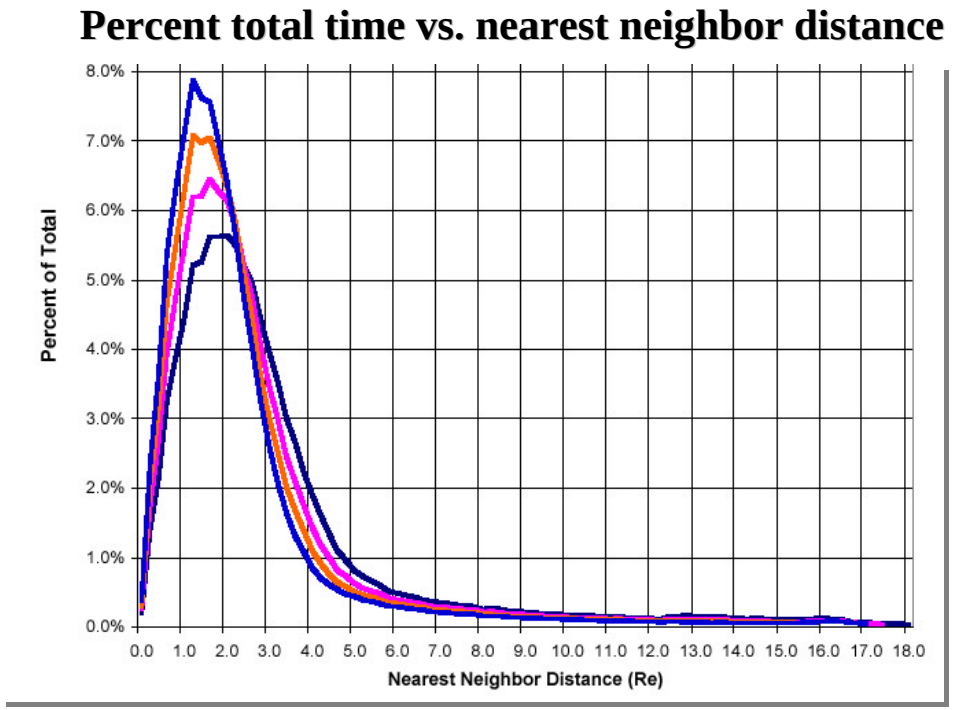
Mission Concept

- Spacecraft deployed with optimal spatial distribution.
- Prime mission conducted while in magnetotail; secondary science on flanks and dayside.
- Excellent constellation coverage and evolution over two-year mission.

- Spacecraft distributed in 3x7 Re to 3x40 Re low inclination, nested orbits.
- DRACO "nearest neighbor" spacing peaks at 2.0 - 1.0 R_E for ~ 50 - 100 spacecraft.





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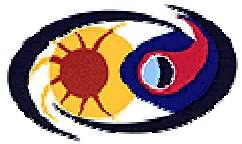
Measurement Requirements



Magnetic Field:
Dynamics
Responses
Connections

Bulk Plasma:
Dynamics
Responses
Connections

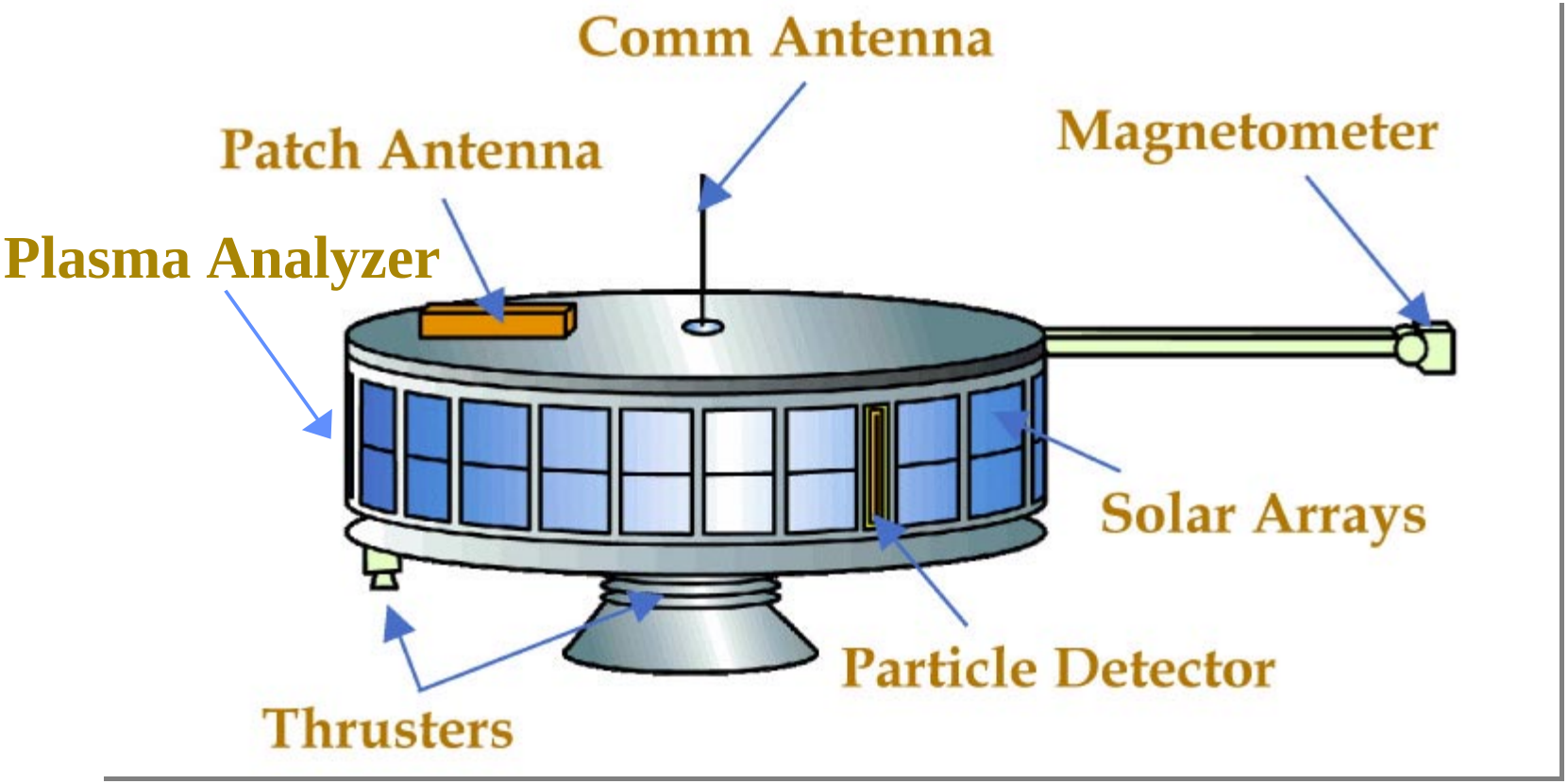
Suprathermal Particles:
Dynamics
Responses
Connections

Measurement	Range	Resolution	Time Resolution	Comments
3-Axis Magnetic Field	+/- 300 nT	0.1 nT	1 sec	Fluxgate technology exists
Plasma 2-D Temperature	10 - 20000 eV	20%	10 sec	Requires 180° field-of-view
Plasma Flux	10^2 - 10^8 cm^{-2} s^{-1} sr^{-1} eV/eV	20%	10 sec	Electrostatic analyzer technology exists
Plasma 3-D Velocity Electron PAD	1 - 1000 km/s	20% 20°	10 sec	Mass analysis significant but not absolutely required.
Particle Energy	20 - 500 keV	20%	10 sec	Mass analysis significant but not absolutely required.
Particle Flux	1E0 - 1E6 cm-2 s-1 sr-1	20%	10 sec	Solid state telescope technology
Particle Pitch Angle	180°	20°	10 sec	

Spacecraft

Mass:	**10 kg**
Payload:	**2.5 kg**
Power:	**10 W**
Size:	**40 x 10 cm**

Evolutionary design based on ST-5 nanosatellite (20kg, 20W)



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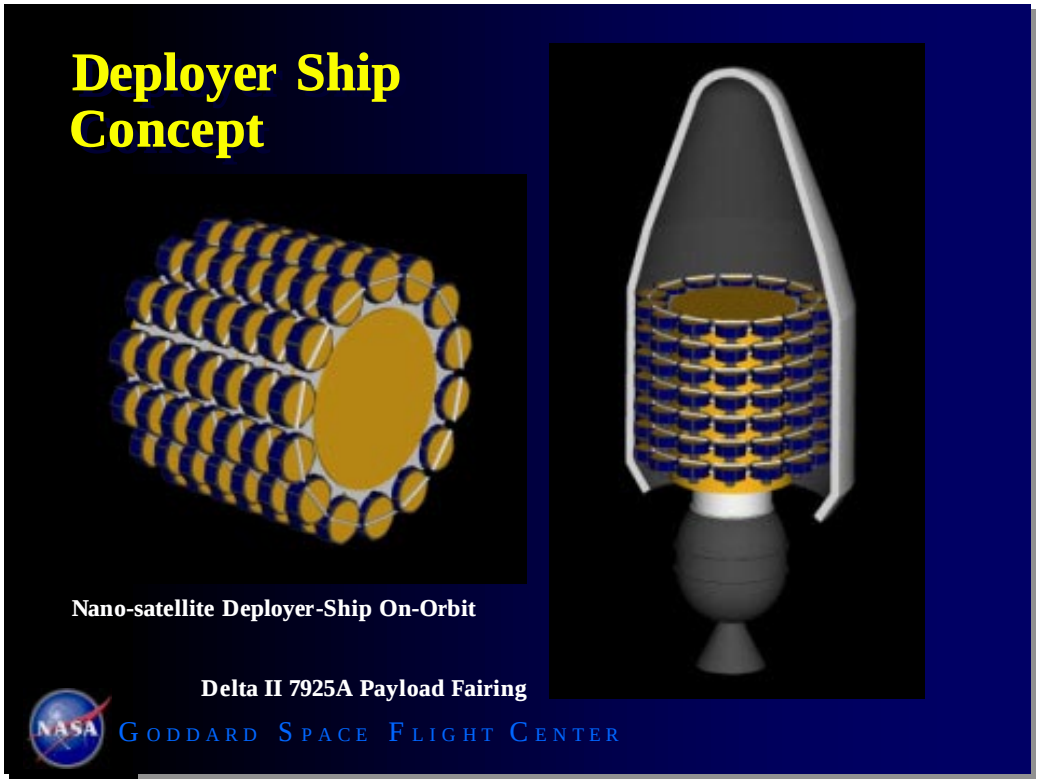
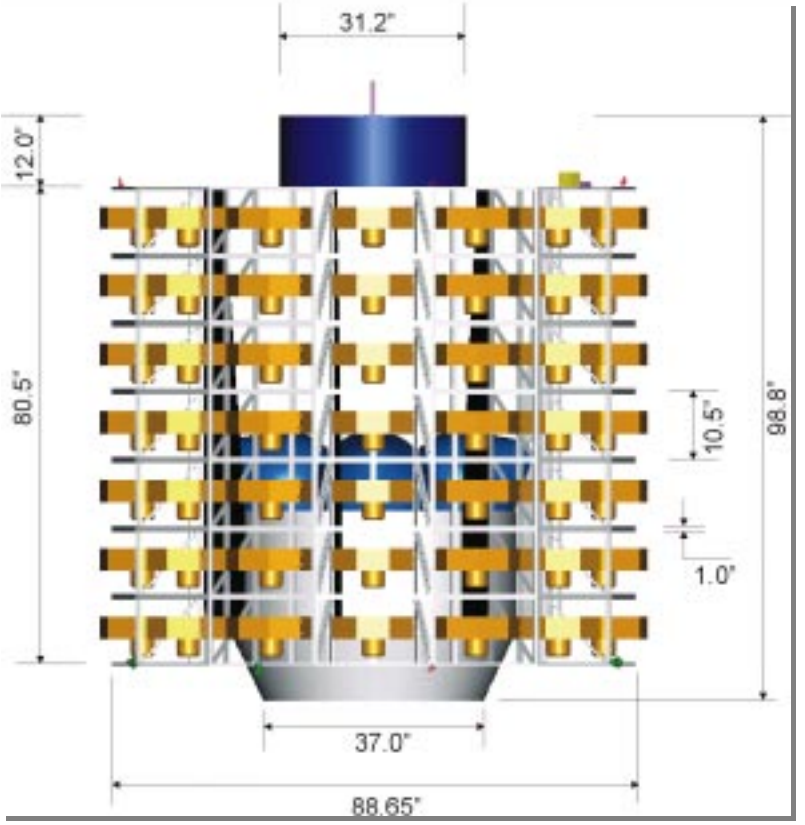
Dispenser Ship

Sized for Delta II Fairing

Capacity ~ 100 nanosats

Preliminary study uses only one launcher to deploy the constellation





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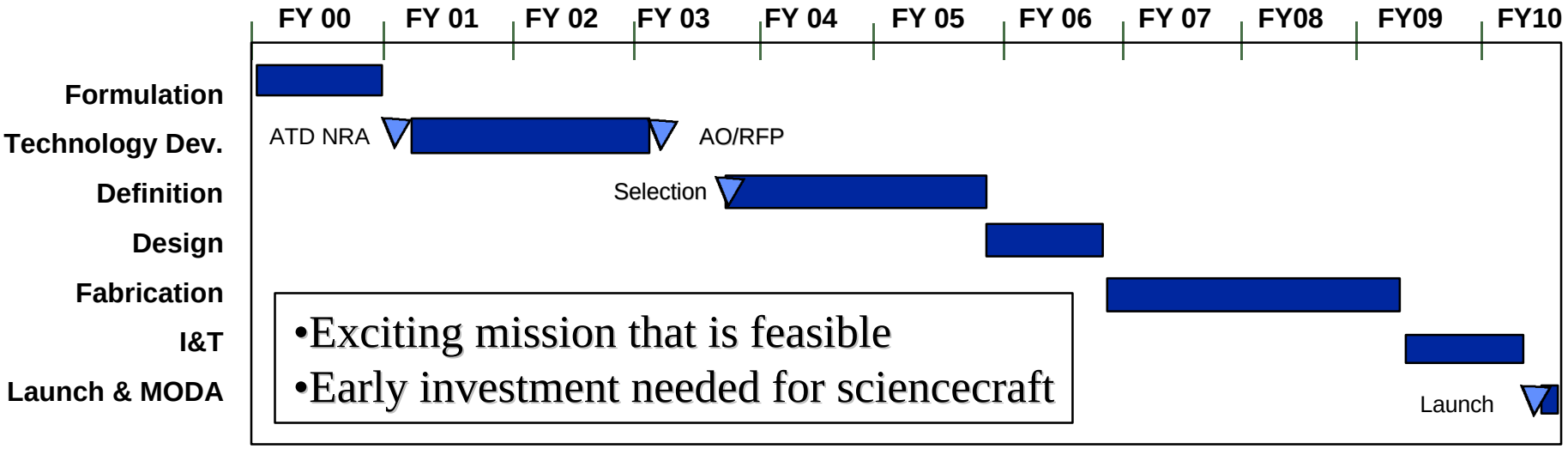
June 2000 Status

FY99-00 Accomplishments:

- MC-STDT formed Feb. 99
  - > Meetings 1 March, 1-2 April, 17-18 May, 12-13 July, 8-9 Sept. 1999, 8-9 May 2000.
- Magnetospheric Constellation DRACO defined
- Mission feasibility/requirements studies:
  - > Science instrumentation (ATD required for “sciencecraft“ miniaturization, manufacturability)
  - > Nanospacecraft
  - > Deployer ship and Orbital deployment
- MC-STDT Report in draft form for community and SECAS input.

Preliminary Schedule (no assumed LWS acceleration)



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